Chemical Process Technologies for Simultaneous NOx Removal in Existing FGD Installations

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SUMMARY

An overview is given of diverse chemical process means being offered, and in some instances applied, for simultaneous SO_2/NO_x removal in wet FGD systems. Each is shown to have significant potential for enhanced removal of elemental mercury as well. Details are reviewed of innovative designs now emerging, in part from earliest developments in Japan in the 1970s. Pursuing such performance objectives, R & D in that country established the oxidation-reduction process mode, uniquely applicable in medium/high sulfur service for conversion/upgrading of those FGD processes in which the wet scrubbing medium is chemically reducing (deoxidizing). Such a wet-scrubber absorption regime, deployed as an integrated multi-pollutant abatement process, is potentially capable of high removal efficiency in chemical reduction of NOx, when it is made available as the gaseous NO_2 species, to form innocuous gaseous N_2 that is discharged to the stack, contained in the clean flue gas. Uniquely, FGD processes that use (and are suitably modified to achieve bolstering of) a chemically reducing, scrubbing-medium regime also operate, nominally/optimally, with zero liquid-effluent outfall discharge. This advantageously precludes potential difficulties in treatment and management of any scrubber wastewater yield containing incidental amounts of dissolved, nitrogenous, secondary reaction-products of NO_x removal. (A comparatively small amount of such NOx removal occurs via side reactions that cause some collected NO2 to report to the scrubbing medium).

Important methods are also reviewed that, more simply, i.e. without physical scrubber-system alteration, achieve fullest oxidation of flue-gas nitrogen oxides, i.e. to gaseous N_2O_5, for assured, high-efficiency NO_x capture in conjunction with SO_2 removal, i.e. irrespective of scrubbing medium in use and fuel sulfur level. Such means of passive use of existing wet limestone scrubbers to augment the performance of an upstream,

principal, secondary deNOx process offers promise of cost-effectively accomplishing a stack NOx emission as low as .01 lb/MM Btu heat input.

The discussion also dwells on the difficult challenge in achieving successful design and operation of SCR means of secondary deNOx in unique but commonplace high-sulfur/low-ash, coal firing applications in the U.S., (such SCR application having no significant overseas precedent). Moreover, additional clear forecasts of ever-tightening NOx emission control goals for U.S. electric utilities indicate the vital importance of gaining a substantial supplementary amount of NOx removal in routine FGD operations for greatest cost-effectiveness in meeting short-term as well as long-term regulatory requirements re. NOx.

Worldwide system-supply candidates include novel, potentially more cost-effective, proprietary system-design arrangements employing diverse pseudo-catalysts, which processes may be cost-competitive with any/all other available secondary deNOx means for application to new generating units. These technologies also offer attractive possibilities in the U.S. for application to very recently installed, wet limestone scrubbers that were retrofitted to reduce annual SO_2 emission inventory in conjunction with the 1990 Clean Air Act Amendments (CAAA), Title IV, (and may thus be feasibly by-passed temporarily for extensive system modifications required).

Means of concurrent improvement in abatement of emission of elemental mercury, these arising from the novel but generally used pretreatment step for oxidation of flue-gas NO, are detailed. Emphasis is given to potentially attractive means and opportunities to economically convert existing FGD systems and to technical and logistical factors that would limit such retrofit conversions.